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a data processor obtaining dielectric anisotropy of the sample from variance of detection outputs of said detectors following switching by said switching driver whereby said orientation measuring instrument measures orientation of a portion of the sample.

REMARKS

This Amendment is made preliminary to continued examination and is in full and timely response to the final Office Action mailed June 15, 2001. Reexamination and reconsideration in light of the above amendments and the following remarks is respectfully requested.

By the foregoing amendment, claims 1-3 were amended to recite that the dielectric resonator(s) are arranged on a first surface of the sample, and that the orientation measuring instrument measures orientation of a portion of the sample. Support for this amendment can be found variously throughout the specification, for example, at page 3, line 30 to page 4, line 27. No prohibited new matter was added. Claims 1-12 are currently pending in this Application, with claims 1, 2, and 3 being independent. Applicant believes that all pending claims are allowable, and this application is in condition for allowance.

Rejections under 35 U.S.C. §103

The Office Action rejected claims 1-12 under 35 U.S.C. §103(a) as being unpatentable over *King* (U.S. Patent No. 5,334,941) in view of *Osaki et al.* (U.S. Patent No. 4,710,700), *Heikkila* (U.S. Patent No. 4,500,835) and *Todoroki et al.* (U.S. Patent No. 5,699,163). Applicants respectfully traverse this rejection. Specifically, Applicants assert that elements of the claims are not taught or suggested by the references and the motivation supplied by the Examiner is insufficient to support the rejection if the claims.

The present invention is directed to an instrument for measuring orientation. The instrument includes a resonator (20) generating a resonance mode and antennas (22a and 22b) for the resonator. The resonator (20) is arranged on a first surface of a sample (25). Dielectric anisotropy of a sample (25) is measured by the variance of the resonance frequency as the

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sample or resonator is rotated. The instrument is applicable to sheet-like samples and three-dimensional molded samples also.

King is directed to an *in situ* sensor for measuring or monitoring the dielectric and conductive properties of solids, liquids and gases at microwave frequencies. The sensor uses a microwave resonator (11) that is in contact with a sample (9). An electric field is generated and the reflection energy data is processed to determine dielectric anisotropy of the sample under test. *King* also discloses that the orientation of fibers can be determined through measurements of the sensor. The Examiner acknowledges *King* fails to teach a rotation mechanism for rotating the sample or the resonator, and relies on the other cited references to make up for this deficiency.

Regarding the rejection of claim 1, Applicants also respectfully point out that the resonator 20 of the present invention is a dielectric resonator. On the contrary, *King* discloses a microstrip resonator, which is different from a dielectric resonator. Although the Office Action appears to regard the resonator 11 of *King* as a dielectric resonator, *King* does not disclose, teach or suggest a dielectric resonator.

The dielectric resonator 20 of the present invention has a plane being in contact with a sample, the plane exuding evanescent waves from the inner part of the dielectric resonator, so that it generates an electric field vector having a unidirectional component in an in-sample plane parallel to the plane of the dielectric resonator 20 with high Q value of resonance. Furthermore, the resonator 20 couples with a test material by the plane, resulting in a strong electromagnetic coupling. As a result, the dielectric resonator 20 of the present invention can determine dielectric anisotropy with high sensitivity.

In contrast, *King* discloses microstrip resonators, for example, as described in the phrases "microstrip resonator sensors" on line 20 in column 1 and "microstrip resonators" on line 33 in column 2. A microstrip resonator is different from a dielectric resonator in its operating principals of resonance and functions. The difference between the two types of resonators is discussed in the previously filed document "MICROWAVE ENGINEERING", the partial translation of which was also provided.

Microwave resonators are classified as follows:

1. Cavity resonators
2. Resonators for MIC (Microwave Integrated Circuit)
    1) Dielectric resonators
    2) Ferrite resonators
    3) Planer line resonators
        Micro strip line resonators
        Slot line resonators
    4) Conductive disk resonator
    5) Concentration constant resonator
3. Other Resonators
    1) Traveling-wave resonator
    2) Fabry-Perot resonator

King discloses "a micro strip line resonator" which belongs to the class of planer line resonators, but does not disclose "a dielectric resonator", "a ferrite resonator" and "a cavity resonator". The resonance of a micro strip line resonator is determined by the line length of the resonator, and therefore it can be called a one-dimensional resonator. (Please see page 4 of the translation of the literature.) That is, it resonates with a frequency number of resonance in which the line length is equal to integral times of half wavelength of resonance.

On the contrary, a dielectric resonator has a three-dimensional body having at both ends in the resonance direction magnetic wall faces by means of which microwaves reflect to confine a resonance energy within the body. The reflection at the faces results from the fact that the dielectric constant of the dielectric resonator itself is, for example 20 or 50, which is much larger than the dielectric constant 1.0 of air.

The resonance of a dielectric resonator has various kinds of resonance modes including three-dimensional resonance modes such as TM_{201}, where the numeral "201" means a number of antinodes of electric field in the direction of X, Y, and Z respectively. Please see Fig. 16(B) of the present application. However, a micro strip line resonator does not have any three-dimensional resonance mode.

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King discloses a sensor 20 consisting of a highly conducting (e.g. metal) microwave resonator 11, which is provided on the surface of a dielectric substrate 12 (Fig. 2, column 10, lines 35-41). The resonator 11 is a microstrip resonator, which is essentially a linear antenna, but not a dielectric resonator. Although the resonator 11 has the dielectric substrate 12, the dielectric substrate 12 is placed at the opposite side of the test material 9 with respect to the resonator 11, hence the dielectric substrate 12 does not contribute to resonance.

It follows that *King* performs measurements at a line, i.e. "one-dimensionally", while the present invention performs measurements at a plane, i.e. "two-dimensionally".

In a micro strip line resonator, the Q value of the resonance is not very high due to the radiation loss. (Please see page 4 of the translation of the literature.) On the contrary, a dielectric resonator has generally high Q value (an inverse of tan δ) inherently up to 100000 due to no radiation loss because it can confine almost the resonance energy within the body. On the other hand, there is an evanescent wave exuding from the surface of a dielectric resonator, the electric field strength of which decreases exponentially depending to the distance from the surface. The present invention basically depends on the fact that the resonance frequency is shifted by the perturbation between the evanescent wave and a sample.

It is thought that the inherent Q value of the resonator of *King* cannot be defined, because tan δ cannot be known since the resonator does not have any dielectric body to be resonated.

As a result, the antenna resonator 11 has a low Q value of resonance, and it is difficult to find a suitable resonance peak for measuring dielectric constant. Furthermore, since the antenna resonator 11 has a linear shape, an electromagnetic coupling with a test material is weak, and this results in a low sensitivity of measurements. The sensor 20 having the antenna resonator 11 may be able to determine dielectric anisotropy, however, the sensitivity is low.

Regarding claims 2 and 3, the Office Action alleges that the operational mode involving a plurality of resonators in Fig. 7 of *King* corresponds to a plurality of dielectric resonators and a plurality of sets including sets of microwave exciters of the present invention. Applicants respectfully traverse this assertion too.

In claim 2, there are provided a plurality of dielectric resonators, which generate electric filed vectors having directions different from each other. In claim 3, there are provided a

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dielectric resonator and a plurality of sets of microwave exciters and detectors, which generate electric field vectors having directions different from each other. The resonators claimed in claims 2 and 3 can determine dielectric anisotropy of the sample while neither the sample or the dielectric resonators are rotated.

In contrast, the sensor 50 shown in Fig. 7 of *King* has multiple microstrip resonators 11a, 11b, and 11c, which have different corresponding lengths La, Lb and Lc so as to resonance at different frequencies (column 11, lines 53-58). These resonators 11a, 11b, and 11c generate field vectors having the same direction. Therefore, sensor 50 shown in Fig. 7 *King* <u>cannot</u> determine dielectric anisotropy of the sample by switching excitation of the resonators 11a, 11b and 11c in turn.

As discussed below, Applicants respectfully assert that the other references cited in the above rejection fail to teach or suggest a dielectric resonator as opposed to a microstrip resonator and that the rejection is improper for failing to disclose, teach or suggest all of the elements of the claims.

Osaki et al. is directed to a method of measuring orientation or dielectric characteristics of sheets or webs. A sweep oscillator (4) emits a linearly polarized wave that is directed by a transmitting antenna (5) such that the emitted microwaves fall on the surface of a sheet (3) at right angles thereto. Transmitted waves are received by a detector (13) and either the sample (Fig. 1) or the upper and lower waveguides (1 and 2) are rotated. The variation of the resonance frequency with angle of rotation is determined to provide the relative orientation of the sheet. Applicants respectfully assert that there is no motivation to combine the references, as discussed below.

Heikkila is directed to method and apparatus for detecting grain direction in lumber. Microwave radiation is either passed through or reflected from a piece of lumber (1) being tested. The radiation is introduced by a transmitting antenna (3) and received by a receiving antenna (2), where the antennas have polarizations that are 90° out of phase. Signals received are compared to determine the grain direction of the lumber. Applicants note that while the Examiner has relied upon this reference to show that the prior art teaches the rotation of the sample or the resonator, neither is taught by *Heikkila. As* such, Applicants respectfully assert that

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Heikkila cannot be relied upon to teach or suggest rotation of the sample or resonator and, therefore, this portion of the rejection must be improper.

Todoroki et al. is directed to a method of determining the orientation of fibers on the surface of a paper. The method uses a laser beam with a projecting unit (6) and a receiving unit (7), where the receiving unit receives and detects the intensity of the light reflected from a surface (1 a) of a paper (1). The sample table (2), upon which the paper rests, is rotated and the intensity is determined as a function of rotation angle to determine the orientation of fibers in the paper. Applicants note that the method disclosed in *Todoroki et al.* is applicable to only flat surfaces, such as paper or cloth. Applicants also note that while the sample table does indeed rotate, it does not rotate with respect to the plane of a dielectric resonator. Rather the rotation occurs about a center point (3) through which inclination of the sheet is made.

In addition, Applicants also note that *Todoroki et al.* teaches away from the combination of the references. *Todoroki et al.* disclose the detection of orientation of a sheet using polarized microwaves (column 1, line 59 - column 2, line 6), but indicates that such measurements cannot occur over a relatively short time and do not rely on purely surface measurements (column 2, lines 7-13). A prior art reference "must be considered in its entirety, i.e., as a whole, including portions that would lead away from the invention in suit", *Panduit Corp. v. Dennison Mfg. Co* ., 810 F.2d 1561, 1568 [1 USPQ 1593, 1597] (Fed. Cir. 1987). *Todoroki et al.* teaches away from the combination of the references and for at least this reason, Applicants respectfully assert that the rejection is improper.

Applicants also assert that the motivation provided in the rejection is insufficient to support the rejection. The Examiner alleges that "[t]he suggestion/motivation for doing so would have been that, as already noted, relative rotation between the sample and the microwave source, as well as a transmission mode of testing, are both widely used in the art." Applicants respectfully assert that this does not supply motivation but instead alleges a possibility that the references could be combined. There is no reason provided that suggests any benefit from the combination.

To establish a *prima facie* case of obviousness, there must be some motivation or suggestion, either in the references themselves or within the knowledge generally available to

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one of ordinary skill in the art, to modify the reference & to combine reference teachings. The fact that a given modification would have been "well within the ordinary skill in the art" or generally known in the art is not sufficient to establish a *prima facie* case of obviousness. Ex parte Levengood, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993). Just because an aspect of the invention may be "obvious to try" does not provide the proper motivation under §103. As such, Applicants assert that the rejection is improper for failing to supply motivation to combine the references.

In addition, Applicants assert that one of ordinary skill in the art would not have been motivated to combine the references as provided in the rejection because the process discussed in each are very different. Even though the Examiner explicitly states that *King, Osaki et al., Heikkila* and *Todoroki et al.* are "analogous art", that does not provide motivation. *King* discloses a microwave resonator that is placed in contact with a sample but all of the other references are explicitly non-contact methods. In fact, *Osaki et al.* extols the virtues of its methods over prior art dielectric detection methods because the non-contact method allows a larger number of measurements in a short time (column 2, lines 59-68). As such, Applicants assert that one of ordinary skill in the art would not have been motivated to combine the references because of their inherent differences.

As such, Applicants respectfully assert that the rejection of claims 1-12 is improper for failing to disclose, teach or suggest all of the elements of the claims. Applicant therefore respectfully requests that claim 1-12 be found allowable, and this application be passed to issue.

Applicants will now address the additional points raised by the examiner in the June 15, 2001 final Office Action.

1. The Office Action alleges that the preamble is not being given any patentable weight. While Applicants disagree with the examiners allegations, especially since the body of the claims recite the components of the orientation measuring instruments, in order to expedite prosecution, by this Amendment claims 1-3 were amended to recite that

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"said orientation measuring instrument measures orientation of a portion of the sample."

2. The Office Action alleges that "the microstrip resonator of King to be "equivalent" to, under the Doctrine of Equivalence, the dielectric resonator recited in the claim." Applicants understand the examiner's confusion about the Doctrine of Equivalence, as this Doctrine is only applicable when dealing with the subject of claim infringement, and has no bearing on the determination of patentability. With respect to the role equivalence can play in making an anticipation rejection, equivalence must be evaluated in view of the descriptions in the present specification and the submitted extrinsic evidence. As discussed above, <u>Applicants assert that the resonator of King and the dielectric resonator as claimed are not the same, nor are they equivalents</u>. It is also noted that the examiner offers a discussion that equivalence can be used as a rationale for obviousness, however the rejection does not make such a statement, rather, the examiner only refers to the resonators as being equivalent.

3. The examiner further alleges that that the functions of the devices in King and the present invention are the same or similar and that the substitution of functional equivalents is allowed in an obviousness rejection. However, as stated above, the resonator of King is structurally different from that of the dielectric resonator of the claimed invention, and that difference is highlighted in the claims by the specific recitation of a dielectric resonator. While the examiner asserts at page 11, lines 3-5 of the Office Action that no specific resonator is recited, a reading of the originally filed and the amended independent claims shows that a dielectric resonator is specifically recited.

4. The examiner discusses at great length that the "acknowledged prior art" discloses the rotation of a sensor and a dielectric resonator. However, the examiner has failed to rely on such teachings in the rejection. If the examiner wishes to cite the

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acknowledged prior art in the rejection, the examiner must do so explicitly in the rejection.

5. The examiner asserts that the secondary references are "mere exemplars" and that "no actual combining of references involved in here [sic]." As the examiner should be aware, the combination of references in an obviousness rejection involving more than one reference is always a consideration. In making the rejection, the examiner is arguing for the obviousness of the claims in view of references and the arguments provided. Whether the applied references should be taken in combination is a consideration in applying 35 U.S.C. §103 and the examiner should not dismiss Applicants' arguments about teachings of the references that do not suggest the combination.

Withdrawal of the §103 rejections is respectfully requested.

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Conclusion

For the foregoing reasons, claims 1-12 are allowable, and the present application is in condition for allowance. Accordingly, favorable reexamination and reconsideration of the application in light of these amendments and remarks is courteously solicited. If the examiner has any comments or suggestions that would place this application in even better form, the Examiner is requested to telephone the undersigned attorney at the number below.

Respectfully submitted,

Date: December 14, 2001

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Should additional fees be necessary in connection with the filing of this paper, or if a petition for extension of time is required for timely acceptance of same, the Commissioner is hereby authorized to charge Deposit Account No. 180013 for any such fees; and applicant(s) hereby petition for any needed extension of time.

Appendix I

In accordance with 37 CFR 1.121(c)(1)(ii), amended claims 1-3 are set forth in a marked-up version below:

1. (Amended) An orientation measuring instrument comprising:

a dielectric resonator having a plane [being close to or] being in contact with a sample, sample dielectric resonator arranged on a first surface of the sample;

a microwave exciter generating an electric field vector having a unidirectional component at a frequency in the vicinity of the resonance frequency of said dielectric resonator when the sample is present and in an in-sample plane parallel to said plane in said dielectric resonator;

a detector detecting transmission energy or reflection energy by said dielectric resonator;

a rotation mechanism rotating said sample or said dielectric resonator in a plane parallel to said plane; and

a data processor obtaining dielectric anisotropy of the sample from variance of a detection output of said detector following rotation by the rotation mechanism whereby said orientation measuring instrument measures orientation of a portion of the sample.

2. (Amended) An orientation measuring instrument comprising:

a plurality of dielectric resonators comprising planes [being close to or] being in contact with a sample and arranged close to each other, said dielectric resonators arranged in a first surface of the sample;

a microwave exciter generating electric field vectors having unidirectional components, being electric filed vectors having directions different from each other at a frequency in the vicinity of the resonance frequency of said dielectric resonator when the sample is present and in an in-sample plane parallel to said planes in the respective dielectric resonators;

detectors for the respective dielectric resonators detecting transmission energy or reflection energy by these dielectric resonators; and

a data processor obtaining dielectric anisotropy of the sample from variance of detection outputs by said detectors at said electric field vectors of different directions from said plurality of dielectric resonators whereby said orientation measuring instrument measures orientation of a portion of the sample.

3. (Amended) An orientation measuring instrument comprising:

a dielectric resonator having a plane [being close to or] being in contact with a sample, said dielectric resonator arranged on a first surface of the sample;

a plurality of sets, being sets of microwave exciters generating electric filed vectors having unidirectional components at a frequency in the vicinity of the resonance frequency of said dielectric resonator when the sample if present and in an in- sample plane parallel to said plane in said dielectric resonator and detectors detecting transmission energy or reflection energy by said dielectric resonator, arranged on positions different from each other with respect to said dielectric resonator;

a switching driver selecting one set among said plurality of sets of microwave exciters and detectors and sequentially driving the same; and

a data processor obtaining dielectric anisotropy of the sample from variance of detection outputs of said detectors following switching by said switching driver whereby said orientation measuring instrument measures orientation of a portion of the sample.